

RARE EARTH ELEMENTS



Rare Earth Elements — Lanthanum (La), Cerium (Ce) and Praseodymium (Pr)
— have been shown to support the following:

- An increase in crop yields up to 15% in some plant species, particularly if moisture was limiting. Confirmed in greenhouse and field conditions
- Rare Earth Elements may enhance nitrogen fixation by Azotobacter species
- Rare Earth Elements may enhance absorption of ions by root hairs
- Rare Earth Elements may enhance manganese and iron absorption
- Rare Earth Elements may enhance Photosystems I & II efficiencies
- Rare Earth Elements have enhanced abscisic acid production
- Rare Earth Elements have been shown to help plants contend with stress
- Rare Earth Elements may stimulate Mg-ATPase in photosynthesis
- Rare Earth Elements enhance the Hill Rxt of Photosynthesis
- Rare Earth Elements have inhibited fungal growth (*Cercospora nicotianae*)

Boron (B)

- Boron helps develop roots and shoots for young, growing plants
- Boron is known to impact metabolic pathways in plants, probably by some unknown cascade impact on regulatory molecules
- Boron is known to have a role in the biosynthesis and development of structural elements in plant cells.
- Boron is known to improve the integrity of the plasma membrane of all cells
- Boron is known to impact the uptake of sugar from its primary site of production to needy tissues.

Copper (Cu)

- Copper makes up many important enzymes in plants, notably nitrogen reductase.
- Copper is an essential part of photosynthesis
- Copper is required as part of plant cell walls

Cobalt (Co)

Root nodule bacteria is required to fix nitrogen, therefore the presence or absence of Co has a direct bearing on legume plants.

Iodine (I)

Some chemical forms of iodine appear to stimulate various plants. For example iodate, not iodide, stimulates the growth of a wide range of plants.



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Manganese (Mn)

- Manganese is involved in many plant functions, especially activating several enzyme systems
- Manganese is part of photosynthesis
- Manganese is part of protein synthesis

Molybdenum (Mo)

- Necessary for nitrogen fixation
- Used by the enzyme systems nitrogenase and nitrate reductase
- Involved in nitrogen metabolism
- Makes up an important part of chlorophyll
- Essential for iron and phosphate metabolism

Nickel (Ni)

The most recent element added to the essential trace element list. Pecans are among plants known to require Ni for fruit production.

Arsenic (As)

At very low concentrations, has been known to stimulate plant growth. At high concentrations it is toxic to plants.

Selenium (Se)

Selenium is essential for animals and for bacteria, including the nitrogen-fixing bacteria. Essentiality in higher plants is controversial.

Tin (Sn)

Tin is absorbed by plant root hairs and generally not redistributed elsewhere in the plant. Inorganic tin is generally unavailable to plants. Few studies have been conducted to determine if tin is helpful to plants.

Vanadium (V)

Vanadium is essential for the formation of chlorophyll in several forms of algae (lower plants). Its role in higher plants is not yet clear.



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Zinc (Zn)

- Zinc is essential for many different enzyme systems in plants
- Zinc is important for synthesizing nucleic acid
- Zinc is utilized in metabolizing the hormone Auxin

Tungsten (W)

Tungsten interacts with molybdenum and at < 5 ppm W has been reported to have a positive impact on a variety of higher plants.

